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EMPIRICAL ANALYSIS AND REFINEMENT OF EXPERT SYSTEM  
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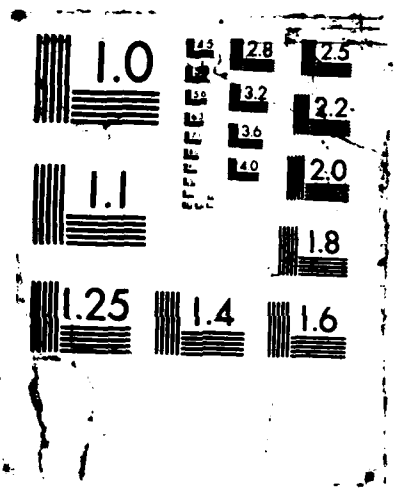
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RUTGERS UNIVERSITY  
Center for Expert Systems Research

Quarterly Report:  
Empirical Analysis and Refinement of  
Expert System Knowledge Bases  
Contract Number  
N00014-87-K-0398  
Office of Naval Research

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## 1. Technical Project Summary

Knowledge base refinement is the modification of an existing expert system knowledge base with the goals of localizing specific weaknesses in a knowledge base and improving an expert system's performance. Systems that automate some aspects of knowledge base refinement can have a significant impact on the related problems of knowledge base acquisition, maintenance, verification, and learning from experience. The SEEK system was the first expert system framework to integrate large-scale performance information into all phases of knowledge base development and to provide automatic information about rule refinement. A recently developed successor system, SEEK2, significantly expands the scope of the original system in terms of generality and automated capabilities.

Based on promising results using the SEEK approach, ~~we~~ <sup>the project investigators</sup> believe that significant progress can be made in expert system techniques for knowledge acquisition, knowledge base refinement, maintenance, and verification.

## 2. Principal Expected Innovations

We are proposing to demonstrate a rule refinement system in an application of the diagnosis of complex equipment failure. The expected candidate application is computer network troubleshooting. The expert system should demonstrate the following advanced capabilities:

- automatic localization of knowledge base weaknesses
- automatic repair (refinement) of poorly performing rules
- automatic verification of new knowledge base rules
- some automatic learning capabilities.

## 3. Objectives for Fy88

- functioning equipment diagnosis and repair knowledge base, suitable for refinement (expected in the area of computer networks).
- initial demonstration of functioning equipment diagnostic system with capabilities of localization of weak rules, automatic refinement, automatic verification.
- demonstration of initial rule learning capabilities.

#### 4. Summary of Progress

The initial starting date of this contract is September 1, 1987. However, the official notice of funding was not received by the investigators until October. Thus progress has necessarily been limited. However, some progress has been made in meeting our stated objectives for fiscal 1988. Here are the highlights:

- Dr. Peter Politakis of the Digital Equipment Co. transferred to us DEC's Network Troubleshooting Consultant program that we proposed to use in our system. Dr. Politakis directed the development of this software and will serve as our expert in the refinement of the knowledge base. We have circumscribed the knowledge base to the following problem types: line, circuit, or cable problems. This subset of the knowledge base consists of 287 observations, 138 hypotheses, and 324 rules.
- We have made arrangements with Dr. Politakis to obtain some documented cases of network problems. He has supplied eight so far, and we hope to obtain several dozen others from DEC's stored records. These will be supplemented by simulated cases derived from verified correct rules in the knowledge base. (These rules may be partially hidden from the refinement system.)
- We have made substantial progress in our rule induction systems. Several experiments are underway using data obtained from other researchers who have published results. These include data from Michalski and Quinlan. These efforts are extensions of our procedures we reported at the AAAI-87 conference. Results of these new experiments will be reported in a future quarterly report.

Because the contract began in midsemester, we must delay hiring of research assistants until next semester: January 1988. Other staff members are in place.



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